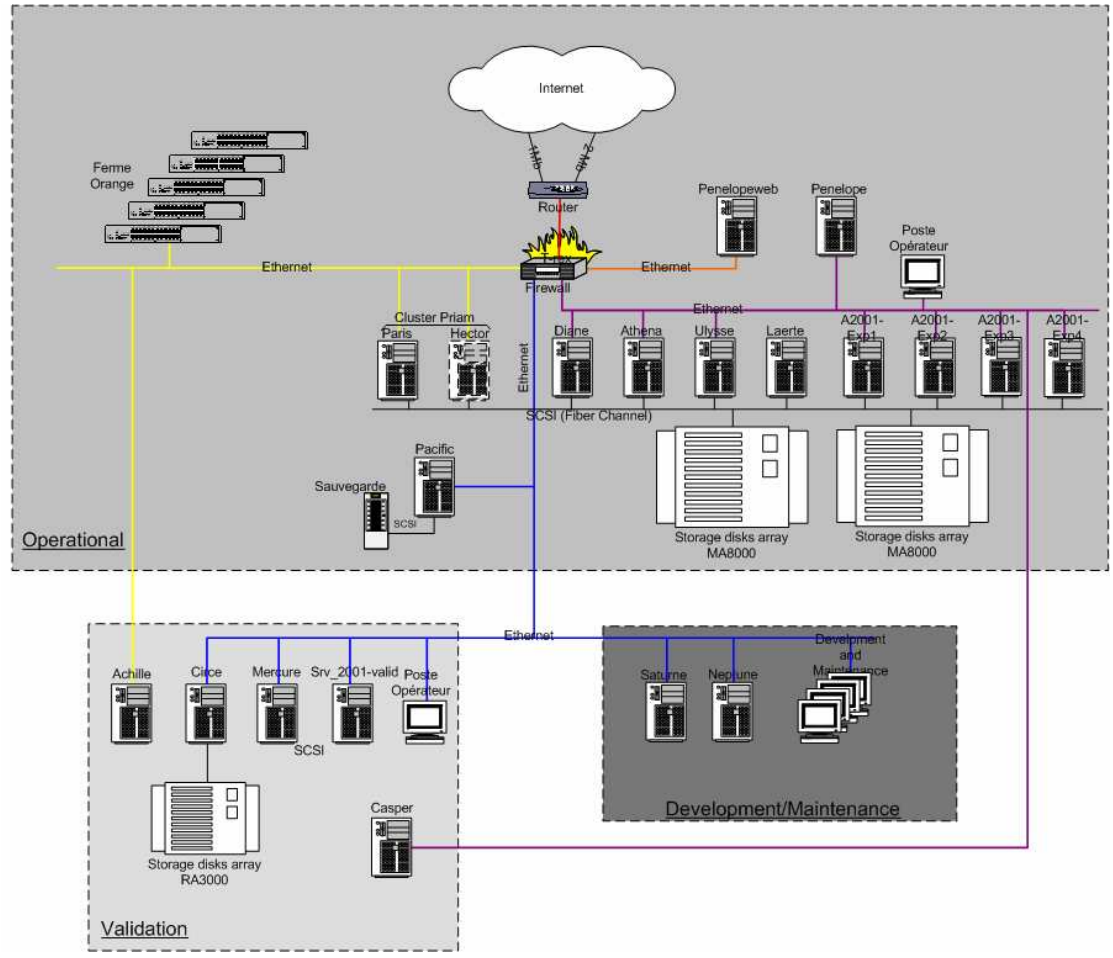
Agenda item F-2.3

41st Argos Operations Committee meeting
Prepared by CLS
Date : May, 15th 2007

SYSTEM IMPROVEMENTS

1. Hardware configuration

The computing architecture dedicated to the Argos system is still the same and no significative modification is to be mentioned in 2006.



The heart of the architecture is composed of two high performance disk storage arrays on which are connected, via fiber channel links, the servers involved in the process of the Argos data.

The operational configuration is of course dedicated to the acquisition, the processing and the dissemination of the Argos data, 24 hours a day, all along the year. The development and the maintenance of the Argos software are performed on

a dedicated architecture. The third configuration, the validation configuration, is used to validate all the software modifications and corrections before being installed at the level of the operational configuration.

Our project of creating a second computing center in addition to the existing CLS computing center is still alive even if the installation of the communication links between both centers caused a big delay in the project. It seems that the problems are now fixed. The project can go on.

2. Ground segment architecture

The Argos ground segment is composed as follow :

- the real time acquisition network
- the Global Argos Control and Processing centre
- the regional processing centers
- the PTT and PMT

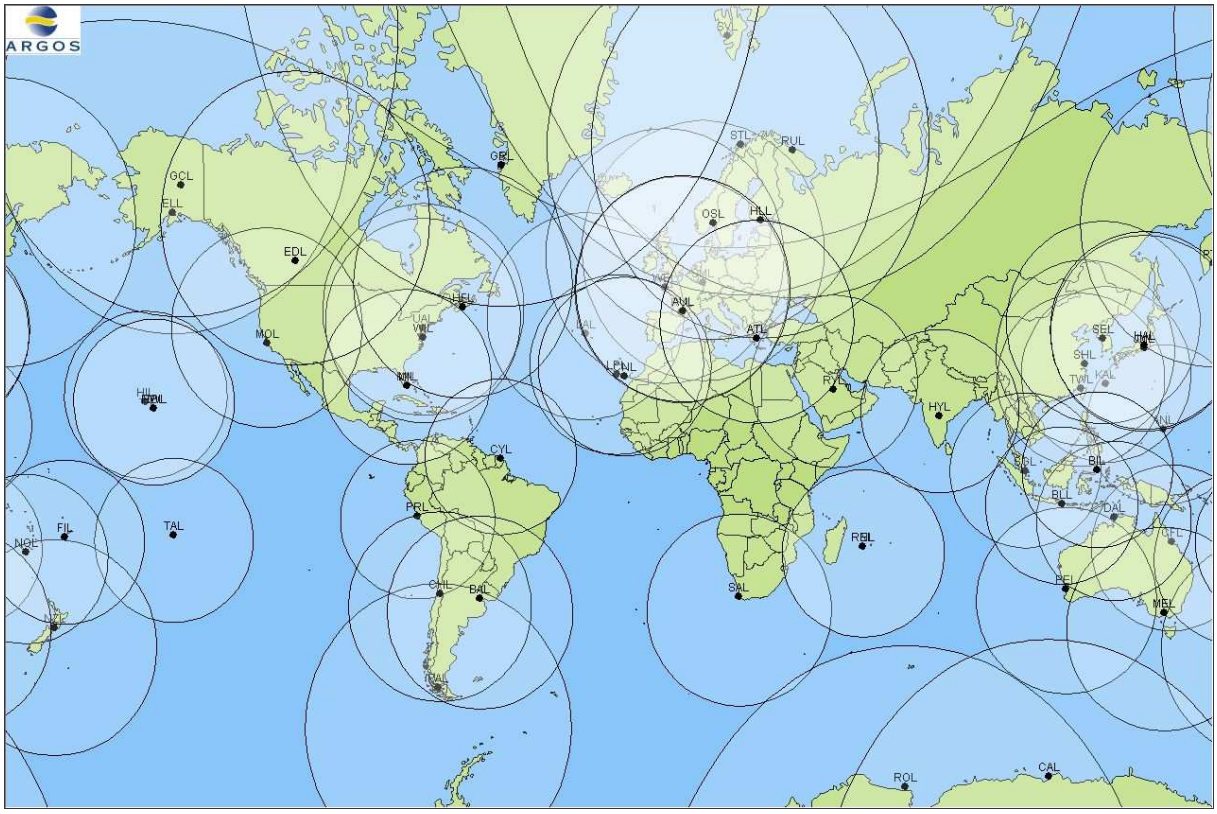
2.1 The real time acquisition network

8 new NOAA HRPT ground stations have joined the Argos real time acquisition network in 2006 that brings the total number to 58 antennas.

The 8 new ground stations added in 2006 are the following :

Location	Country	Operator	Satellites
Cape Fergusson	Australia (Queensland)	NOAA	NOAA-18, NOAA-17, NOAA-16
Andersen	Guam	USAF	NOAA-18, NOAA-17, NOAA-16, NOAA-15, NOAA-14, NOAA-12
Elmendorf	Alaska	USAF	NOAA-18, NOAA-17, NOAA-15, NOAA-14, NOAA-12
Hickam	Hawai	USAF	NOAA-18, NOAA-17, NOAA-16, NOAA-15, NOAA-14, NOAA-12
Kadena	Japan	USAF	NOAA-18, NOAA-17, NOAA-15, NOAA-14, NOAA-12
Lajes	Portugal (Azores)	USAF	NOAA-18, NOAA-17, NOAA-15, NOAA-14, NOAA-12
Sembach	Germany	USAF	NOAA-18, NOAA-17, NOAA-15, NOAA-14, NOAA-12
Valley Forge	USA (Pennsylvania)	Lockheed Martin	NOAA-18, NOAA-17, NOAA-16, NOAA-15, NOAA-14, NOAA-12

Most of the 58 ground stations which compose the Argos real time network acquire HRPT data from the satellites NOAA-18, NOAA-17, NOAA-16, NOAA-15, NOAA-14 and NOAA-12. After the acquisition and a slight processing, the stations deliver the TIP data both to CLS and CLS America processing centers.



Argos real time acquisition network

This network was built as time goes by, usually to answer to the needs of covering specific areas of the world and sometimes by taking advantage of the cooperation opportunities which were offered.

Even if we are ready to consider any new opportunity of cooperation, we would like to focus now our efforts on adding new ground stations compatible with NOAA and METOP satellites.
To initiate this new acquisition network, CLS has based its strategy according two main axis :

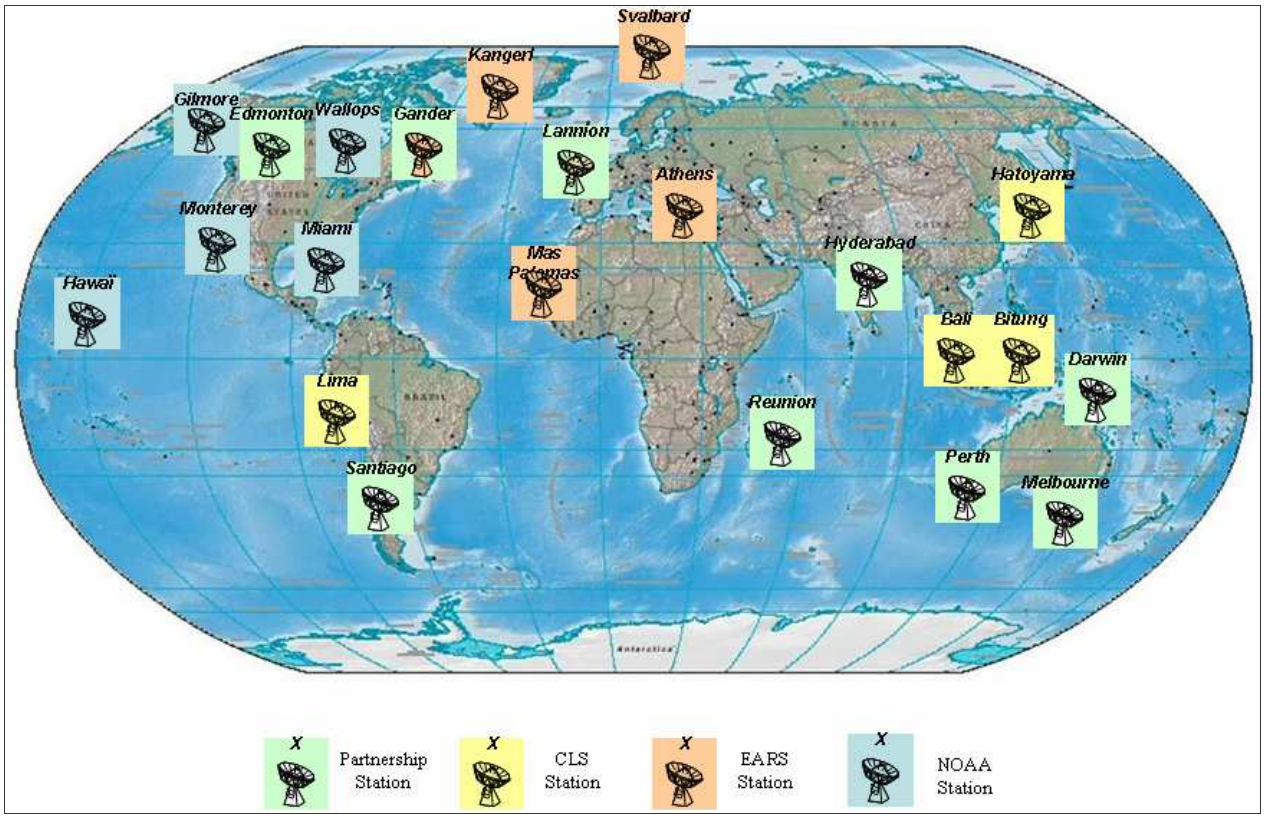
- to invest in its own NOAA/METOP stations,
- to cooperate with a partnership network

CLS has already bought four NOAA/METOP ground stations. Two DataTools antennas (French manufacturer) which are located in Indonesia, in Bali and in Bitung and two Konsberg antennas (Norwegian manufacturer) respectively installed in Lima (Peru) and in Tokyo (Japan). These four ground stations are not yet operational for METOP.

Regarding the partnership network, CLS is in contact with NOAA, EUMETSAT (EARS network) and several other meteorological agencies such Environment Canada, Meteo Chile, Meteo France, INCOIS (India) and Bureau of Meteorology

(Australia).

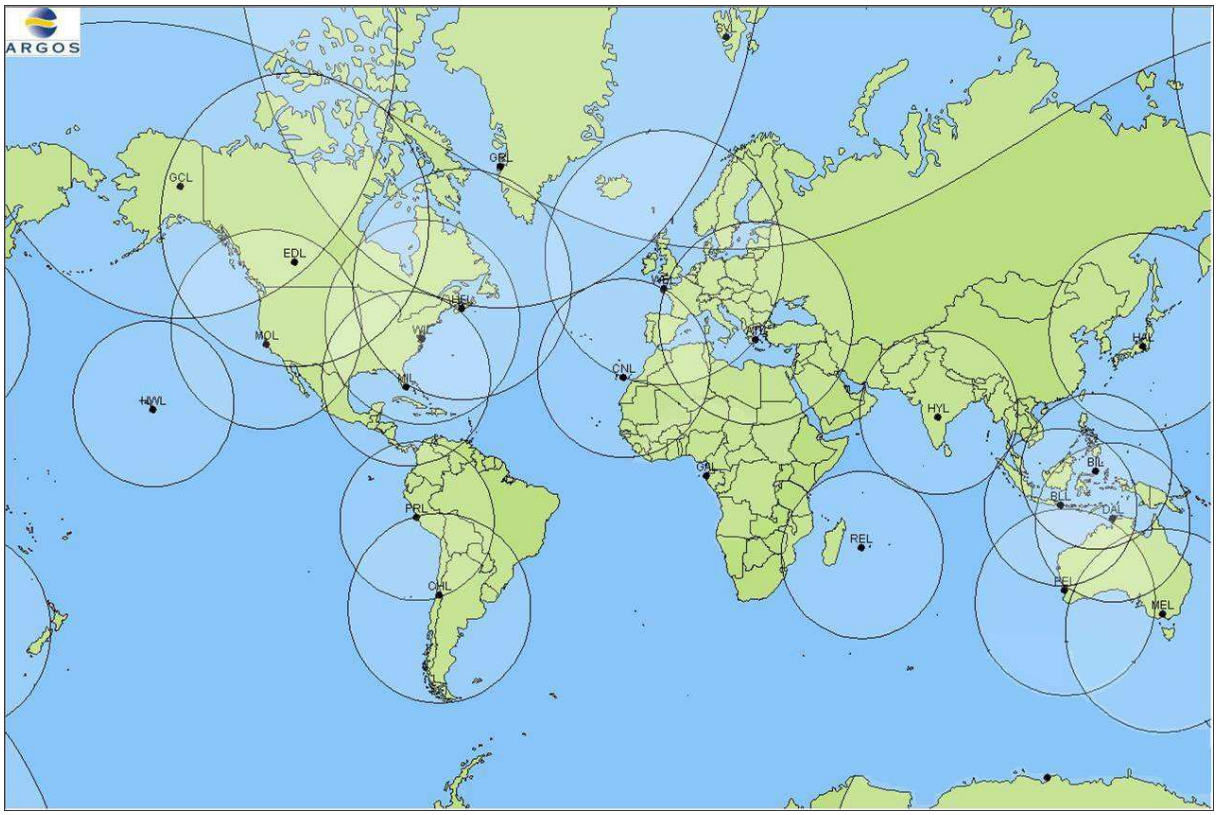
Today, the expected NOAA/METOP network is the following :



	Antennas	Country	Operator
1	Darwin	Australia	BOM
2	Melbourne	Australia	BOM
3	Perth	Australia	BOM
4	Bali	Indonesia	CLS
5	Bitung	Indonesia	CLS
6	Hatoyama	Japan	CLS
7	Lima	Peru	CLS
8	Kangerlussaq	Greenland	EARS - Danish Meteo Institute
9	Svalbard	Norway	EARS - EUMETSAT
10	Athens	Greece	EARS - HNMS (Meteo)
11	Mas Palomas	Spain	EARS - INTA
12	Edmonton	Canada	Environnement Canada

13	Gander	Canada	Environnement Canada
14	Hyderabad	India	INCOIS
15	La Reunion	France	IRD
16	Santiago	Chile	Meteo Chile
17	Lannion	France	Meteo France
18	Gilmore / Fairbanks	USA	NOAA
19	Hawaii	USA	NOAA
20	Miami	USA	NOAA
21	Monterey	USA	NOAA
22	Wallops	USA	NOAA

In term of coverage, we could expect :

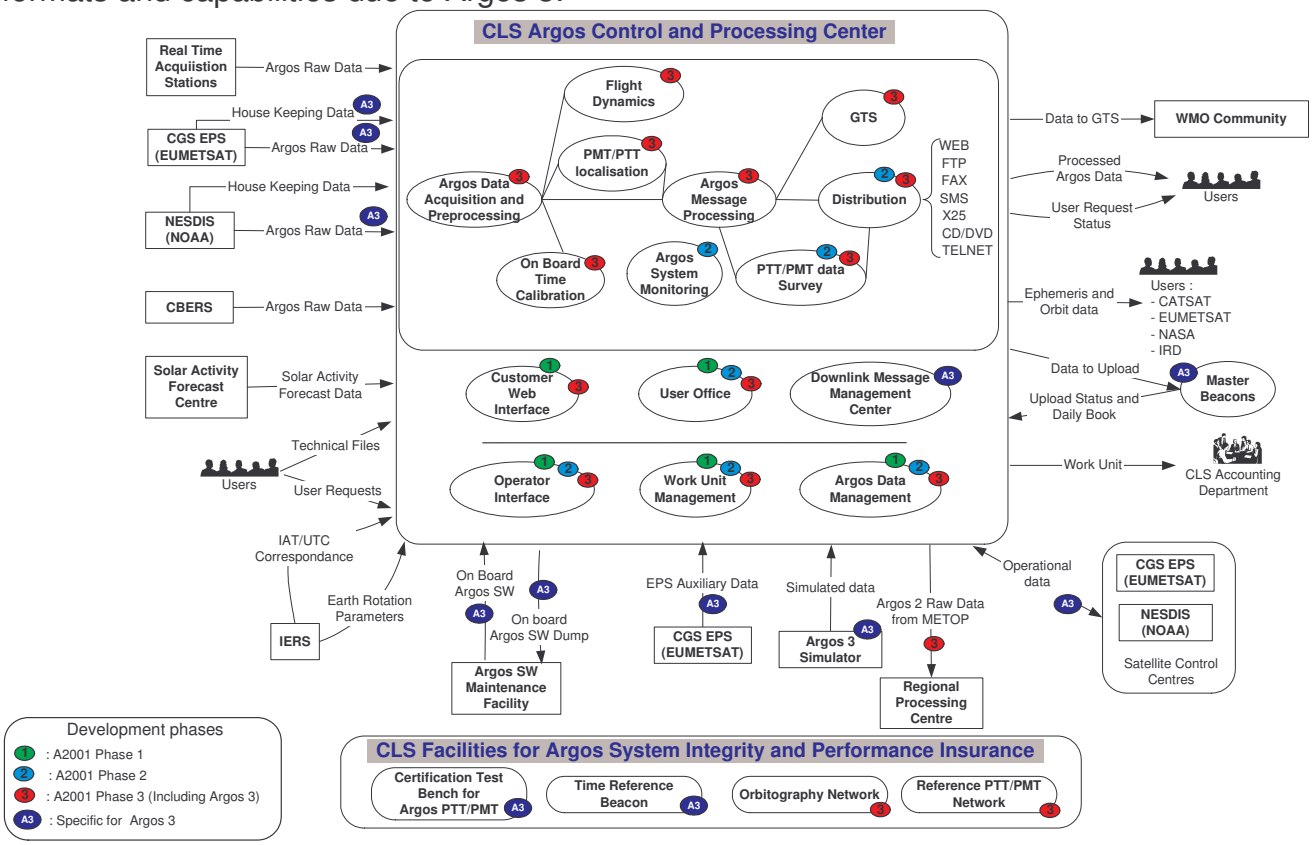


2.2. Argos Control and processing centre

The Global Argos Control and Processing centre is mainly improved through two projects:

- A2001 project (see chapter 2.2.1),
- Argos 3 ground Segment project (see chapter 2.2.2).

The figure below gives an overview of all components and interface of the processing center that have been added or modified during the development described afterwards. It shows which system is impacted by the phases of the Argos 2001 project and which subsystems have been updated to take into account the new formats and capabilities due to Argos 3.



2.2.1 Argos 2001

The purpose of the Argos 2001 project was to upgrade the entire Argos control and processing centre. This ambitious project was vital for the long-term continuity of the Argos system and needed to offer a better level of services to our users in terms of new functionalities, reliability, availability and responsiveness to their requests.
This project was divided into three phases:

Phase I: Development and implementation of a new user interface allowing users to access data and view and update technical files via a Web server. The System Use Agreements database will also be implemented during this phase. Data will be stored and managed by a database management system designed to be responsive to users' needs. Our objective is to give users more versatility if they require. Consequently, we will be expected to offer them quick and efficient support.

Phase II: Improvement and development of value-added services as well as tools for the Argos system monitoring

Phase III: Fully redesign of the Argos Core processing called phase IIIA (i.e. mainly acquisition, preprocessing, localisation) and the GTS processing called phase IIIB.

Current status:

Phase I and Phase II:
Both phases are now ended and operational at both centres (France and US). The new applications is regularly improved either to fix anomalies or to implement new functions. The last main improvement has been the new WEB site ArgosWeb. It has been open in latest 2006. It is based on new technologies; it offers a new design, better performances and better maps. The ArgosWeb will be regularly upgraded to provide new functions (see www.argos-system.org).

Phase III:
The phase III concerns the processing of the Argos data and then includes the Argos 3 telemetry processing.
The Integration and validation activities have been delayed due to the following main reasons:

- New functionalities have been requested and implemented,
- The global performance requirements has been harder to meet than foreseen,
- The launch campaign of Argos 3 (on board of METOP A) had impacts on the project team organization.

The objective is to put into operation the A2001 Phase IIIA by the second quarter 2007 and the Phase IIIB by the last quarter 2007.

2.2.2 Argos 3 ground segment (SSA3 project)

The SSA3 project has been over since September 2006.

In March 2003 started a new and major project for Argos named: SSA3 (Argos 3 ground segment). This project is aiming to take into account all the changes in the current Argos ground segment brought by the third generation of Argos instruments. It includes the downlink and the new format for the uplink messages (new modulation, high bit data rate…) as well as the interface with EUMETSAT.
The sub-systems of the Argos 3 ground segment development shall be completed and validated for the first METOP satellite launch which will be called METOP A. This launch is foreseen on July,17 2006, the Argos 3 instrument will be switch on 11 days after.
This project is driven in parallel with the Argos 2001 Phase III project and then the first milestone is now the delivery of the Argos 2001 phase III delivery which is scheduled in early 2006.

The Project covers the following developments:

- Argos 3 control and processing: it includes

    - Evolutions of the Argos Core Processing and distribution i.e. all sub-systems modified due to the Argos 3 capabilities and characteristics,
    - The DMMC (Downlink Message Management Center) dedicated to Argos 3
- Time Reference Beacon,
- A new network of master beacons (High data rate platforms),
- Argos PTT/PMT test bench.

Argos 3 Control and Processing Center

The integration tests with EUMETSAT started in July 2005. The data are now received through EUMETCAST which is the system that broadcasts the products generated by EUMETSAT.
The Integration, Validation and Verification phase started in April 2005. The full IV&V of the Argos 3 ground segment is done in parallel with the IV&V of the A2001 Phase III. It started in December 2005 and is now over for Argos3. All functions involved in Argos3 telemetry processing and downlink message management have been tested.

The last tests to be run are the tests with the instrument Argos 3 on board of METOP A. These tests will be run after the full commissioning of the instrument in May 2007.

Time Reference beacon

The new generation of the Time Reference beacon is operational and has been successfully used during the Argos 3 commissioning phase.

Master Beacon

Three Master Bacons, compliant with Argos 3 instrument, have been set up: one in Svalbard, one in Fairbanks and the last one in Toulouse. They are currently operational and used for Argos 3 commissioning.

Certification Test Bench for Argos PTT/PMT

This facility is regularly used to check the new PTT/PMT series regarding the Argos general specifications. This test equipment is now plan to be upgraded to improve its performances and to add functionalities. These improvements are driven by the CNES.

2.3 PTT/PMT for users

The Argos-3 satellite generation will allow users to have a two-way communication as well as a better control of uplinks at a higher data rate. To access to these new facilities, users will have to implement a PMT (Platform Message Transceiver) in place of their current PTT.
This module, working as a modem, will support:

- transmission of uplink messages using several possible modulation links as well as satellite pass predictions
- reception and processing of downlink messages (commands, predefines messages, satellite acknowledgement,…).

- communication with the platform for the acquisition of sensors and the delivery of an acknowledgement when data string has been correctly transmitted and acknowledge by satellites.

Users will access to these functions in two steps. The first one through “PMT demo units” or first generation PMTs, currently available. The second one through “Industrial PMT RF modules” that will be available mid 2007.

2.3.1 First generation PMTs

Very first PMTs were developed in 2002 / 2003 by Bathy Systems (Boston / USA) in collaboration with Seimac Ltd (Halifax / Canada), a major transmitter manufacturer. These units worked only with uplink BPSK modulation (400 bits/sec.) and a downlink BPSK modulation (200 bits/sec.). They were built around existing modules making the end-product rather large and expensive but fine for running demos. This work, as well as the collaboration between different manufacturers, gave CLS the opportunity to order in May 2005 a set of 80 of these “First generation PMTs” to Seimac Ltd with the implementation of some evolutions to take into account the Argos-3 main new features (downlink at 400 bits/sec. and new high data rate uplink). Seimac delivered 80 of these units in June 2006.

Seimac PMT RFM

Following the authorization given by Cnes to communicate with MetOp A, CLS did the very first interactive communication sessions on May 10th with a user PMT!

Extract of the communication with MetOp in Low then in High data rate:

```
PMT>corb
Time (UTC) Thu May 10 10:05:29 2007

 4 ( NOAA 14) AOS Thu May 10 10:44:46 2007 in 00:39:17 (00:17:08) Max.El 50
 5 ( NOAA 15) AOS Thu May 10 14:29:16 2007 in 04:23:47 (00:12:12) Max.El 07
 6 ( NOAA 16) AOS Thu May 10 12:19:12 2007 in 02:13:43 (00:05:24) Max.El 00
 7 ( NOAA 17) AOS Thu May 10 10:51:46 2007 in 00:46:17 (00:17:48) Max.El 59
 8 ( NOAA 18) AOS Thu May 10 11:09:18 2007 in 01:03:49 (00:14:48) Max.El 13
10 ( METOP 2) OVERHEAD with 00:16:49 left to go.

PMT>send
Waiting...
```

```
1234567890

Message has been pending since:   Thu May 10 10:05:44 2007

01 00 -> FFFE2F540EDE8BD67381011234567890FFFF

Sending Request for Interactive
PMT>

RECEIVED: 40EDE8B50231F200E574

Interactive Session Go-Ahead Message

PMT>
Mode 1: Message 01 sent 1 time(s)
PMT>

RECEIVED: 40EDE8B501D673AA67

Acknowledgement of an Interactive PMT uplink message within a session.
ACK on Message #1

PMT>mode /d 2
MODE 2 - HD Interactive
Pending messages have been discarded
PMT>send
Waiting...
123456789123456789

Message has been pending since:   Thu May 10 10:12:34 2007

01                                              00                                              ->
999666960C906E9E756FB9FE6DF191435B1A413191435B1A437F4E0554870A494B601D934975CA36D1A3070C43
33CFA75D4CF78E5C6FFE39481AB87C3044ABD72873116D7D570C4783682EDA3794E09834EF231B573325EB865A
AF8FDDEFDDBFD6CB71CAD69000

Mode 2: Message 01 sent 1 time(s)
PMT>
PMT>

RECEIVED: 00000BE500A41C48888C152A1E4528C6BAFC190042B74A68

ALLCAST_SATELLITE_ORBIT_PARAMETERS
Writing new Orbital Parameters!
PMT>
Mode 2: Message 01 sent 2 time(s)
PMT>

RECEIVED: 40EDE8B50165DE857E

Acknowledgement of an Interactive PMT uplink message within a session.
ACK on Message #1
-----------------------------------------------------------------
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2.3.2 Industrial PMT RF module

The success of the Argos-3 project will also be based on the availability of low cost, low consumption and tiny “PMT RF modules”. These modules correspond functionally to the previous first generation PMT demo units but designed “from scratch”. In other words, instead of building a final product with the assembly of existing modules we have redesigned the complete product to make it simpler on a single “electronic board”. This work started early in 2005 with some consultant studies on possible technical solutions as an analysis of the volume of the market.

CLS issued late 2005 a Tender to select the best candidates for this development. Selection of providers was done late February 2006 with the election of Kenwood in Japan and Elta in France. Both companies presented to CLS an excellent and complete proposal (technical financial, quality,..).

Today both manufacturers are ready for the certification process and should deliver their final product version by late June 2007. This development has reached its goals in terms of product definition and constrains (size, consumption,..) as well as on the cost.

Elta PMT RFM


Kenwood PMT RFM

2.4 Regional processing centers

Three regional processing centers still exist : Lima in Peru, Djakarta in Indonesia and Tokyo in Japan. However, except the Peruvian center, these regional centers should be stopped before the end of 2007 because they are no more really useful for the users.

At the origin (the first one dates from 1989), the regional centers were created to be a local structure capable of processing and disseminating Argos data faster and cheaper than a global processing center to the users of a specific area. With the generalization of Internet and the multiplication of the regional ground stations, the global processing centers offer the same level of service and even better if we consider the high level of availability of the global centers.

Moreover, the new functionalities of the Argos 2001 software cannot be implemented without deeply modifying the hardware architecture of the regional center.

A new concept of Argos regional processing center is being developed by CLS in order to offer a solution to the users who wish to be autonomous and not to depend on the global processing centers.